B-87

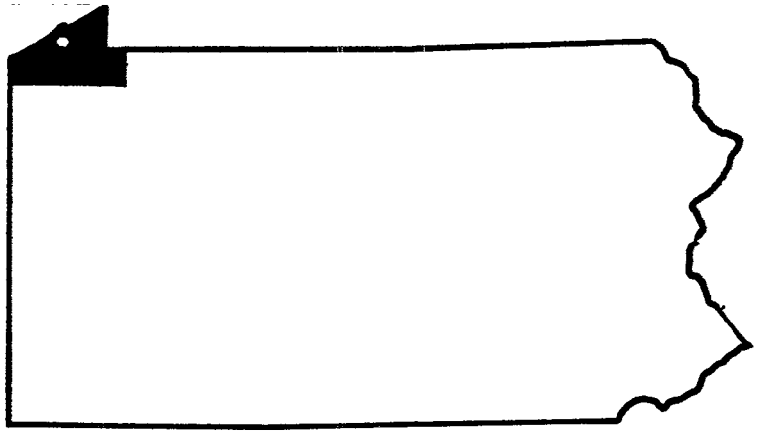
115335

ORIGINAL
(red)

FLOOD INSURANCE STUDY

4

TOWNSHIP OF MILLCREEK, PENNSYLVANIA
ERIE COUNTY



OCTOBER 1978

AR101242

U.S. DEPARTMENT of HOUSING & URBAN DEVELOPMENT

FEDERAL INSURANCE ADMINISTRATION

P-88

ORIGINAL
(red)

TABLE OF CONTENTS

B-89

ORIGINAL
(red)

TABLE OF CONTENTS - continued

AR101244

D-90

ORIGINAL
(red)

FLOOD INSURANCE STUDY
TOWNSHIP OF MILLCREEK, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the Township of Millcreek, Erie County, Pennsylvania, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The initial use of this information will be to convert the Township of Millcreek to the regular program of flood insurance by the Federal Insurance Administration (FIA). Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The identification of streams for detailed and approximate study were selected and agreed upon by representatives of the Township of Millcreek, the FIA, and Michael Baker, Jr., Inc. (the study contractor) at the initial coordination meeting on September 30, 1975.

Agencies, businesses, and individuals contacted for coordination of mapping, hydrologic, and hydraulic information during the course of this study were: the U. S. Army Corps of Engineers, Detroit and Buffalo Districts (COE); the U. S. Geological Survey, Albany, Columbus, and Pittsburgh Districts (USGS); the U. S. Soil Conservation Service (SCS); the Pennsylvania Department of Community Affairs (DCA); the Erie County Planning Commission; the Erie County Public Works Department; Northwest Engineering; township officials; and local citizens.

The township officials were contacted for information as required and were informed of progress on the study. The final Consultation and Coordination Officer's (CCO) meeting was held on April 27, 1978, at which time the results of this study were reviewed by representatives of the Township of Millcreek with representatives of the FIA, representatives of the study contractor, and interested citizens.

ORIGINAL
(red)

1.3 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for the open coast of Lake Erie were performed by the U. S. Army Corps of Engineers for the Federal Insurance Administration (Reference 1).

The hydrologic and hydraulic analyses of the remaining flooding sources for this study, including Erie Harbor, were performed by Michael Baker, Jr., Inc., for the Federal Insurance Administration, under Contract No. H-3812. This work, which was completed in August 1977, covered all significant flooding sources in the Township of Millcreek.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Millcreek. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development and proposed construction through August 1982. The shoreline of Lake Erie and Erie Harbor were studied in detail for the entire length along the township.

The streams in the township that were studied by detailed methods are:

(1) Walnut Creek from a point 0.7 mile upstream of Garries Road to the southern corporate limits.

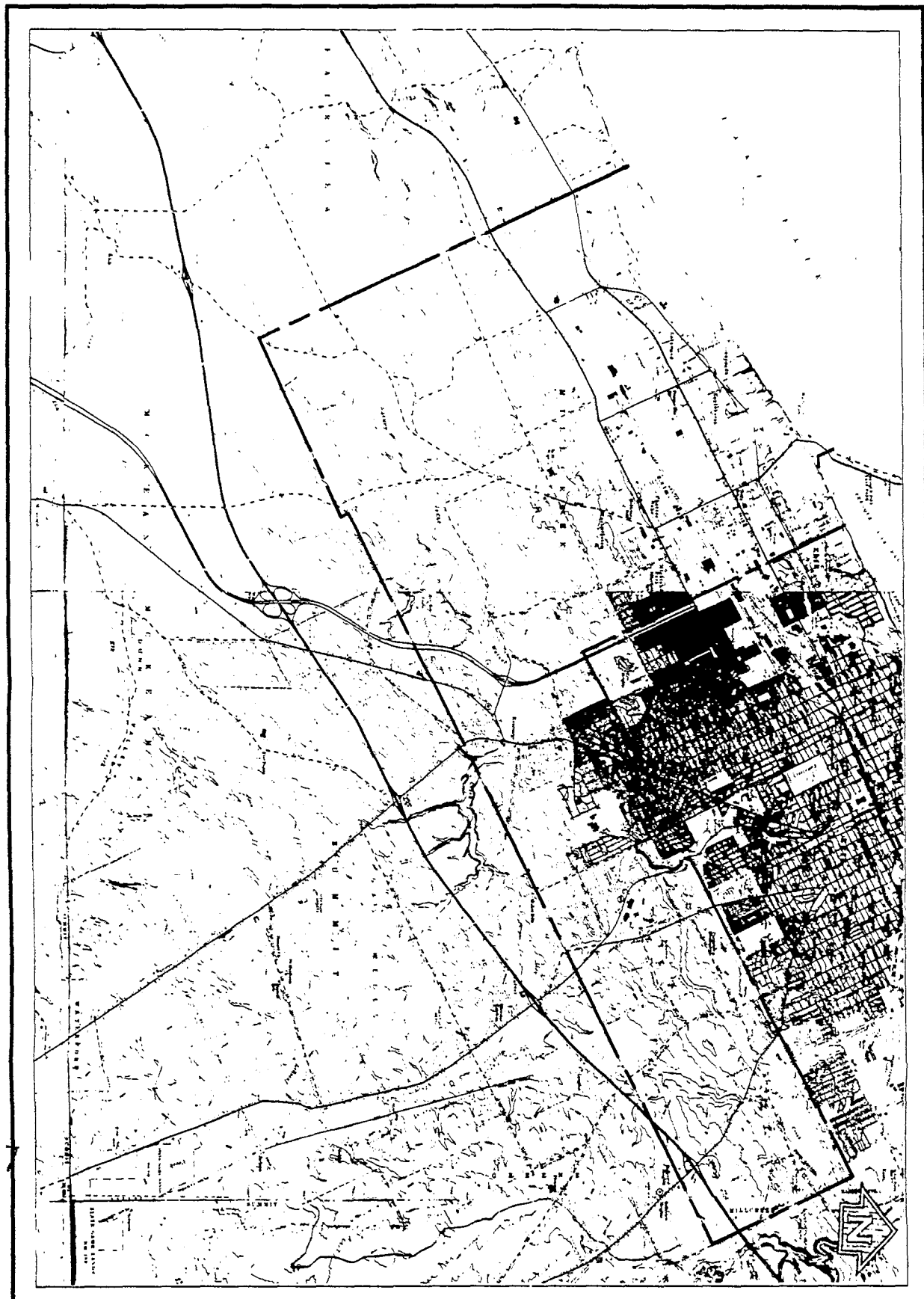
(2) Beaver Run from its confluence with Walnut Creek to a point 0.4 mile upstream of Washington Avenue.

(3) Mill Creek from the northern corporate limits to a point 0.1 mile upstream of Evans Road; and from Lake Pleasant Road to a point 0.3 mile upstream of William Flinn Highway.

(4) Mill Creek Tributary No. 1 from its confluence with Mill Creek to a point 0.1 mile upstream of Conrad Road.

B-92

ORIGINAL
(red)



AR101247

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

APPROXIMATE SCALE
5000 0 5000 10000 15000 FEET

Approximate methods of analysis were used to study those areas having low development potential and/or minimal flood hazards as identified at the initiation of the study. The streams that were studied by approximate methods are those portions of Walnut Creek and Mill Creek not studied by detailed methods, three tributaries of Walnut Creek, one tributary of Mill Creek, an unnamed stream in the northwestern corner of the township and a portion of an unnamed stream in the northern part of the township.

West Branch Cascade Creek, especially from the 15th Street bridge downstream to the corporate limits, flows through a flat, highly developed business area. Along this stretch there are several small culverts which often become clogged with brush, shopping carts, and other debris which cause flood waters to top the low banks and create a shallow flooding situation in large portions of the overbanks. Since the drainage area is less than two square miles and the overbank areas which are subject to shallow flooding are highly developed with small business and shopping malls, most of the damages which would result from flooding is on contents rather than structures. In addition the flooding situation in this area is subject to rapid changes through improvements to the drainage system and new development. West Branch Cascade Creek was therefore studied by approximate methods.

Many of the streams in Millcreek Township have watersheds less than one square mile and generate insufficient volumes of water to produce more than shallow flooding and, therefore, were studied by approximate methods. These streams include Scott Run, Crowell Run, the upper portions of Beaver Run, Mill Creek, Mill Creek Tributary No. 1, and an unnamed stream in the northern part of the township near Marshall Drive, and the small tributaries of Walnut Creek, Beaver Run, Mill Creek, Mill Creek Tributary No. 1, and West Branch Cascade Creek.

The scope and methods of study were proposed to and agreed upon by the FIA.

2.2 Community Description

The Township of Millcreek is situated in north central Erie County in northwestern Pennsylvania. The township is bordered by the Townships of Greene and Harborcreek to the east; the Townships of Greene, Summit, and McKean to the south; the Township of Fairview to the west; and the City of Erie, Presque Isle State Park, Lake Erie, and Erie Harbor to the north.

ORIGINAL
(red)

Walnut Creek, which has its source in the Townships of Summit and Greene, flows westward through the southwestern portion of Millcreek and into Fairview, where it empties into Lake Erie. Mill Creek has its source in Greene and the eastern part of Millcreek and flows westward through Millcreek and then north through the City of Erie and into Erie Harbor. Cascade Creek and its major tributary, West Branch Cascade Creek, form in Millcreek near the western corporate limits of the City of Erie and generally flow northeast through Millcreek into the City of Erie and into Erie Harbor. Several small streams form in the northern part of Millcreek and flow northward into Lake Erie, except Scott Run which empties into Erie Harbor.

The study area encompasses about 34.2 square miles and is located within the glaciated portion of the Allegheny Plateau. The plateau is generally characterized by flat to gently rolling topography. The elevations range from about 540 feet to 1,200 feet. The underlying stratigraphy is composed of shales, thin sandstones and limestone. The bedrock has weathered over the years to form the overlying clay and loam soils. These classes of soil have a slow infiltration rate and thus produce high runoff volumes (Reference 2).

The climate for this area is characterized as "Great Lakes Leeward" with cloudy wet winters and moderate summers. The median winter temperature is 26 degrees Fahrenheit and the median summer temperature is 75 degrees Fahrenheit. With a mean temperature of about 50 degrees Fahrenheit. Average precipitation is 36 to 38 inches per year and snowfall averages 60 inches yearly. Precipitation is uniformly distributed throughout the year (Reference 2).

The Township of Millcreek had a 1970 population of 36,946, a 29.9 percent increase over the 1960 figure (Reference 3). The northwestern section of the township is flat and highly developed with residential dwellings and commercial establishments and a small portion of industrial developments. The major industries produce copper and sheet metal, metal doors, surgical and laboratory supplies, and industrial machinery (Reference 4). The remainder of the township consists of rolling hills about equally divided between open spaces, woodlands, and agricultural lands. There is only minor development located within the flood plains.

2.3 Principal Flood Problems

Due to limited development along the flood plains, only minor flooding usually occurs along the streams. However, more serious flooding can occur when debris or ice block bridge and culvert openings

ORIGINAL
(red)

cause the water to back up behind the restricted opening. Another problem, especially in the flat, highly developed northwestern section of the township, is that in some areas there is insufficient natural slope to permit storm water to flow to the streams, thus creating surface ponding areas. This situation is especially evident in several areas adjacent to the Conrail and Norfolk and Western Railway tracks where even a relatively light rainfall can create ponding areas.

These areas are described in great detail in a study commissioned by the township in 1974 entitled A Comprehensive Storm Drainage Study for Millcreek Township (Reference 5). In the study the ponding areas are described in detail along with recommended improvements to the storm drainage system to alleviate these flooding problems.

On August 3, 1915, a major flood occurred on Mill Creek. Within the City of Erie it killed 35 people and caused approximately five million dollars in damages (Reference 6). Millcreek Township was only sparcely developed at the time and as a result no major flood damages occurred. A check of rainfall records (Reference 7) indicates that the 1915 storm was a rare event with a recurrence interval in excess of 500 years.

2.4 Flood Protection Measures

A section of West Branch Cascade Creek between the Pittsburgh Avenue bridge and the West 12th Street bridge flows along a parking lot in an improved trapezoidal channel with asphalt lining.

Various hydraulic structures have been constructed along the shoreline of Lake Erie and Erie Harbor primarily to prevent erosion. These structures have little effect on flooding along the shoreline.

The Township of Millcreek commissioned a storm drainage study which was completed in 1974 (Reference 5). It provides a plan of action and specific recommendations by which the storm drainage system can be improved within the township. Some of the recommendations have been implemented and additional action is planned on a continuing basis.

Currently county ordinances make it mandatory for new development sites to provide adequate storm water drainage thus minimizing flooding in these areas (Reference 2).

At the time of this report, no other flood protection projects affecting flooding within the township are in existence or are proposed within the near future.

P-46

ORIGINAL

(red)

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10, 50, 100, and 500 years have been selected as having special significance for the flood plain management and flood insurance premium rates. The analyses reported here reflect current conditions in the watersheds of the streams and the Great Lakes.

3.1 Hydrologic Analyses

Hydrologic analyses were conducted to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail within the Township of Millcreek.

There were no gaging stations on the streams within Millcreek and only one gage within Erie County with seven years of continuous records. As a result the peak discharges for Walnut Creek, Mill Creek, Mill Creek Tributary, and Beaver Run were based on a log-Pearson Type III analysis of seven gages in similar watersheds (Reference 8). The gages used as the basis of the analysis are as follows:

Gage Number	Stream and Location	Drainage Area	Number of Years of Record
1981	Norwalk Creek at Norwalk, Ohio	4.92	29
2001	Plum Creek at Oberlin, Ohio	4.88	29
2110	Rock Creek at Rock Creek, Ohio	69.2	25
2115	Mill Creek at Jefferson, Ohio	82.0	33
2125	Ashtabula River at Ashtabula, Ohio	121.0	47
2162	Scajaquada Creek at Buffalo, New York	15.7	17
2165	Little Tonawanda Creek at Linden, New York	22.0	49

Data from each of the five Ohio gages were analyzed using the COE Hydrologic Frequency Program (Reference 9). The flows developed by this program were then compared to the flows published by the USGS

ORIGINAL
(red)

for each of these gages (Reference 10). Due to the close agreement, the USGS published flood flows were used. For the two gages in New York flood flows were developed using the COE program (Reference 9).

For each recurrence interval, a drainage area versus discharge curve was developed using a least squares linear regression. The results were compared to four other hydrologic methods commonly used in areas bordering Erie County. Though not applicable to this lake region, each of these methods produced results which compared favorably with the relationships used in this report. These included PSU III (Reference 11), Floods in Ohio, 1977 (Reference 10), the USGS Method (Reference 12), and Floods in Pennsylvania - Frequency and Magnitude (Reference 13). In all cases agreement was within 10 percent.

The resultant peak discharges determined for each stream studied in detail are shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
WALNUT CREEK					
Corporate limits	16.6	1,675	2,470	2,825	3,740
Upstream of Beaver Run	14.1	1,475	2,200	2,515	3,355
BEAVER RUN					
Mouth	1.7	310	505	600	865
Upstream of Crowell Run	1.3	255	425	505	735
Upstream of Washington Avenue	1.1	220	370	440	645
MILL CREEK					
Corporate limits	8.8	1,045	1,590	1,835	2,490
Approximately 300' downstream from the Perry Highway Bridge located 200' southeast of the intersection of Perry Highway and Evans Road	6.7	850	1,310	1,515	2,075
Lake Pleasant Road	5.2	700	1,095	1,275	1,765
Upstream of confluence with Mill Creek Tributary No. 1	3.1	485	775	910	1,280
MILL CREEK TRIBUTARY NO. 1					
Mouth	1.4	260	430	515	745

B-48

ORIGINAL
(red)

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding sources studied in detail in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

All cross section data for Walnut Creek, Mill Creek, Mill Creek Tributary No. 1, and Beaver Run were obtained by field measurement. Locations of the selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 3). All bridges were surveyed to obtain structural geometry and elevation data. All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Elevation reference marks used in this study are shown on the maps.

Roughness coefficients (Manning's "n") for Walnut Creek, Beaver Run, Mill Creek, and Mill Creek Tributary No. 1 were developed on the basis of field inspection of the flood plain areas (Reference 14). For Walnut Creek the channel "n" varied from 0.035 to 0.055 and the overbank "n" ranged from 0.06 to 0.07; on Mill Creek the channel "n" varied from 0.035 to 0.052 and the overbank "n" was established at 0.10; on Mill Creek Tributary No. 1 the channel "n" varied from 0.03 to 0.045 and the overbank "n" was established at 0.10; and on Beaver Run the channel "n" was established at 0.045 and the overbank "n" at 0.06.

Starting water-surface elvations for Walnut Creek, Beaver Run, and Mill Creek were estimated by the slope-area method as outlined in the HEC-2 user's manual (Reference 15). Starting water-surface elevations for Mill Creek Tributary No. 1 were taken from the Mill Creek flood profiles for corresponding recurrence intervals.

The water-surface profiles of floods of the selected recurrence intervals were then computed through the use of the COE HEC-2 step-backwater computer program (Reference 16) and were drawn to an accuracy of 0.5 foot (Exhibit 1).

Analyses of levels on the open coast of Lake Erie were based upon records for all the water level gages on the lake's perimeter. The historical water levels were adjusted for present conditions of regulation and subsequently used in the Pearson Type III analysis to establish the flood levels for the selected recurrence intervals.

B-99

ORIGINAL
(red)

The analyses outlined above were obtained from the FIA publication "Great Lakes Open Coast Flood Levels" (Reference 1). The analyses for Erie Harbor were based upon a Pearson Type III analysis of the annual highest level recorded on the water level gage at the harbor inlet. The gage has been in continuous operation since 1959 and thus the 18 years of record were utilized in the analyses. High water elevations and information were obtained from various commercial, public, and private interests and used as a comparison with the Pearson analysis. The final resultant elevations are shown in the "Summary of Elevations," Table 2.

TABLE 2 - SUMMARY OF ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (NGVD 1929) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LAKE ERIE				
Outside Erie Harbor	576.1	576.9	577.1	577.7
Inside Erie Harbor	576.5	577.5	577.8	578.4

The approximate study of the 100-year flood for the remaining small streams in Millcreek was based on standard 7.5 Minute USGS Quadrangles (Reference 17), topographic maps at a scale of 1:2,400 with a contour interval of five feet (Reference 18), information generated by the detailed studies, and field investigation.

Flood elevations are often increased from ice or debris blockages which restrict flow of water through the channel or bridges. The hydraulic analyses for this study, however, are based only on the effects of unobstructed flow. The flood elevations, as shown on the profiles, are thus considered valid only if hydraulic structures remain unobstructed and dams and other flood control structures operate properly and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base

D 100

ORIGINA
(red)

flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each flooding source studied in detail, the boundaries of the 100- and the 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using standard 7.5 Minute USGS Quadrangles at a scale of 1:24,000 with a contour interval of 20 feet (Reference 17), and, where applicable, topographic maps at a scale of 1:2,400 with a contour interval of five feet (Reference 18). For streams studied by approximate methods, the 100-year flood has been developed by field investigation using the topographic maps mentioned above.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). In cases where the boundaries of the 100- and 500-year floods are close together, only the 100-year flood boundary is shown.

Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding; owing to limitations of the map scale or lack of detailed topographic information, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Walnut Creek							
A	3,500	110	574	4.9	850.5	849.5	1.0
B	4,000	68	264	10.7	851.2	851.2	0.0
C	4,680	72	368	7.7	856.2	856.1	0.1
D	5,450	67	313	9.0	859.8	859.6	0.2
E	6,480	70	396	7.1	865.7	865.6	0.1
F	7,590	43	325	8.7	870.3	869.9	0.4
G	8,725	61	389	7.3	875.0	874.6	0.4
H	9,530	55	342	8.3	878.3	877.9	0.4
I	10,620	78	479	5.9	882.6	882.1	0.5
J	11,235	81	466	6.1	884.6	884.5	0.1
K	12,235	85	528	5.3	888.1	888.0	0.1
L	13,470	94	417	6.8	891.2	891.2	0.0
M	14,010	149	595	4.7	893.2	893.2	0.0
N	14,780	133	329	7.7	895.9	895.9	0.0
O	15,420	111	280	9.0	899.5	899.5	0.0
P	16,330	124	315	8.0	907.7	907.7	0.0
Q	16,910	103	290	8.7	912.9	912.9	0.0
R	17,570	67	240	10.5	926.6	926.6	0.0

[1]FEET ABOVE GARRIES ROAD

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF MILLCREEK, PA
(ERIE CO.)

FLOODWAY DATA

WALNUT CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Walnut Creek (continued)							
S	18,150[1]	82	301	8.3	938.2	938.2	0.0
T	18,880[1]	59	331	7.6	947.0	946.7	0.3
Beaver Run							
A	660[2]	36	66	9.1	897.8	897.8	0.0
B	1,170[2]	43	79	7.7	899.6	899.5	0.1
C	1,900[2]	39	172	3.5	903.2	902.7	0.5
D	2,690[2]	65	256	2.0	904.1	903.6	0.5
E	3,600[2]	43	94	5.0	906.4	906.2	0.2
F	4,420[2]	28	79	5.6	912.1	912.0	0.1
G	5,110[2]	23	71	5.3	916.6	916.5	0.1
Mill Creek							
A	269[3]	62	184	10.0	807.3	807.3	0.0
B	1,154[3]	45	238	7.7	814.0	813.8	0.2
C	1,847[3]	59	182	10.1	818.8	818.8	0.0
D	2,588[3]	41	167	9.0	825.1	825.1	0.0
E	3,277[3]	30	161	9.4	831.0	830.8	0.2

[1]FEET ABOVE GARRIE'S ROAD
[2]FEET ABOVE MOUTH
[3]FEET ABOVE CORPORATE LIMITS

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF MILLCREEK, PA
(ERIE CO.)

FLOODWAY DATA

WALNUT CREEK, BEAVER RUN AND MILL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Mill Creek (continued)							
F	300[1]	41	137	9.3	906.2	906.1	0.1
G	1,507[1]	60	319	4.2	915.3	914.4	0.9
H	2,032[1]	36	160	7.9	918.3	917.4	0.9
I	2,696[1]	39	179	7.1	923.9	923.5	0.4
J	3,991[1]	169	899	1.6	933.3	932.3	1.0
K	4,698[1]	59	249	3.7	938.5	938.4	0.1
L	5,272[1]	48	139	6.6	941.5	941.5	0.0
M	5,802[1]	50	110	8.3	947.6	947.6	0.0
N	6,200[1]	45	133	6.9	952.7	952.6	0.1
Mill Creek Tributary No. 1							
A	328[2]	30	164	3.1	939.5	939.5	0.0
B	1,046[2]	28	93	5.6	941.2	940.9	0.3
C	1,989[2]	27	65	7.9	948.2	948.2	0.0
D	2,467[2]	26	116	4.5	951.4	950.8	0.6
E	3,119[2]	22	90	5.7	953.5	952.9	0.6
F	3,849[2]	60	291	1.8	958.4	958.3	0.1

[1]FEET ABOVE LAKE PLEASANT ROAD
[2]FEET ABOVE MOUTH

ARIO 128

ORIGINAL (red)

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF MILLCREEK, PA
(ERIE CO.)

FLOODWAY DATA

MILL CREEK AND MILL CREEK TRIBUTARY NUMBER 1

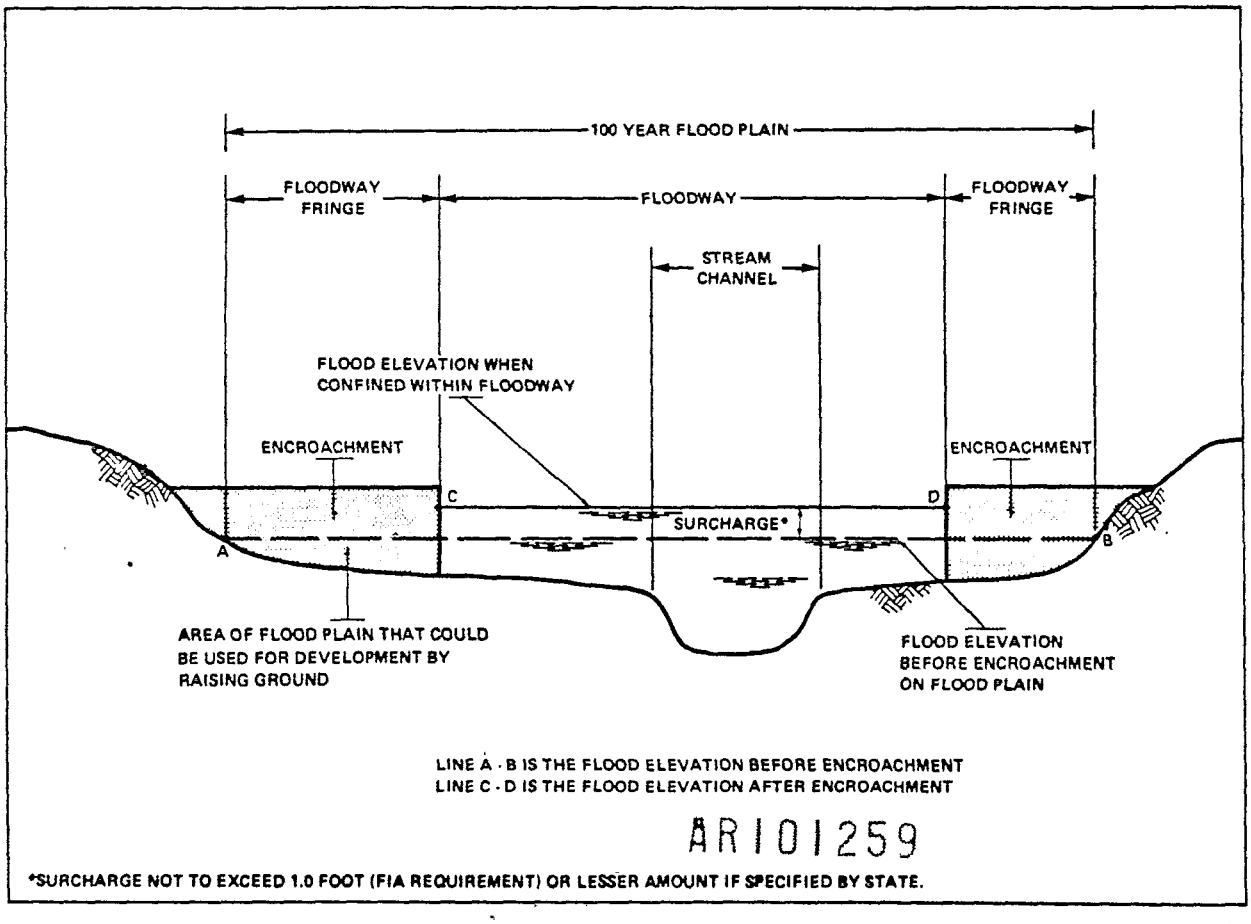
D-104

ORIGINAL
(red)

A floodway is generally not applicable to areas inundated by flood water from Lake Erie and Erie Harbor; thus, there are no floodway limits along the open coast of Lake Erie or Erie Harbor in the Township of Millcreek.

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated and drawn. In areas where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.



FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source affecting the Township of Millcreek.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

Eight reaches meeting the above criteria were required for the flooding sources of Millcreek. These included one on Walnut Creek, one on Beaver Run, two on Mill Creek, two on Mill Creek Tributary No. 1, one for the coast of Lake Erie, and one for Erie Harbor. The locations of the reaches for the flooding sources studied in detail are shown on the Flood Profiles (Exhibit 1) and the locations of the reaches on Lake Erie and Erie Harbor are shown on the Flood Insurance Rate Map (published separately).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Township of Millcreek was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A2, A3, A5:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown and zone designations assigned according to FHFs.
Zone B:	Areas between Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or, areas subject to certain types of 100-year shallow flooding, where depths are less than 1.0 foot. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 4, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Millcreek is, for insurance purposes, the principal result of the flood insurance study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. AR-0126 Base flood elevation lines show the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Walnut Creek							
Reach 1	05, 10	-1.3	-0.4	+0.8	015	A3	Varies
Beaver Run							
Reach 1	05	-1.2	-0.3	+0.8	010	A2	Varies
Mill Creek							
Reach 1	05	-1.6	-0.5	+1.1	015	A3	Varies
Reach 2	05	-1.2	-0.3	+0.9	010	A2	Varies
Mill Creek Tributary No. 1							
Reach 1	05	-1.1	-0.3	+0.6	010	A2	Varies
Reach 2	05	-2.6	-0.3	+0.5	025	A5	Varies
Lake Erie							
Reach 1	10	-1.3	-0.3	+0.6	015	A3	578
Reach 2	10	-1.0	-0.2	+0.6	010	A2	577

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO THE NEAREST FOOT--SEE MAP

(red)

ORIGINAL

D-107

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF MILLCREEK, PA
(ERIE CO.)

FLOOD INSURANCE ZONE DATA

WALNUT CREEK, BEAVER RUN, MILL CREEK, MILL CREEK TRIBUTARY NO. 1 AND LAKE ERIE

6.0 OTHER STUDIES

A study was completed in February 1977 by the COE for the FIA entitled "Great Lakes Open Coast Flood Levels" (Reference 1) and its results are in exact agreement with this Flood Insurance Study.

Flood Insurance Studies are currently being completed for two communities which border the Township of Millcreek. The communities are the City of Erie (Reference 19) and the Township of Fairview (Reference 20). The results of these two studies, when published, will match exactly the results of this study.

Beyond the scope of this report, a study entitled A Comprehensive Storm Drainage Study for Millcreek Township, Erie County, Pennsylvania (Reference 5) provides additional information which would be of use in flood plain management.

No other studies affecting the Township of Millcreek have been found at the date of this study.

This study is authoritative for purposes of the Flood Insurance Program and the data presented here either supercede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Regional Director, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Report On Great Lakes Open Coast Flood Levels, by the U. S. Army Corps of Engineers, Detroit, Michigan, 1977.

2. Northwest Engineering, Erie County Storm Drainage Plan, Erie Metropolitan Planning Department, Erie, Pennsylvania, 1974.

3. U. S. Department of Commerce, Bureau of the Census, 1970 Census of Population, Number of Inhabitants, Pennsylvania, Washington, D. C.: U. S. Government Printing Office, 1971.

ORIGINAL
(red)

4. Pennsylvania Department of Commerce, Bureau of Statistics, Research and Planning, Pennsylvania County Industrial Report - Erie County, Harrisburg, Pennsylvania, 1972.

5. Northwest Engineering, Comprehensive Storm Drainage Study for Millcreek Township, Erie County, Pennsylvania, Tidioute, Pennsylvania, 1974.

6. The Erie Daily Times, City Suffers Greatest Loss in its History, August 4, 1915.

7. U. S. Department of Commerce, Rainfall Frequency Atlas of the United States, TP 40, U. S. Government Printing Office, Washington, D. C., 1961.

8. U. S. Water Resources Council, "Guidelines for Determining Flood Flow Frequencies," Bulletin No. 17, U. S. Government Printing Office, Washington, D. C., 1976.

9. U. S. Army Corps of Engineers, Hydrologic Frequency Analysis, U. S. Army Corps of Engineers, Davis, California, 1975.

10. E. E. Webber, and W. P. Bartlett, Floods in Ohio - Magnitude and Frequency, U. S. Government Printing Office, Washington, D. C., 1977.

11. B. M. Reich, et al, Flood Peak Frequency Design Manual, PSU III, State College, Pennsylvania: Pennsylvania State University, 1971.

12. U. S. Department of the Interior, Geological Survey, Magnitude and Frequency of Floods in the United States. Part 4, St. Lawrence River Basin Water Supply Paper 1677. U. S. Government Printing Office, Washington, D. C., 1976.

13. L. C. Shaw, and W. F. Busch, Floods in Pennsylvania - Frequency and Magnitude. An open-file report of the Pennsylvania Department of Environmental Resources, 1960.

14. U. S. Department of the Interior, Geological Survey, Roughness Characteristics of Natural Channels, U. S. Government Printing Office, Washington, D. C., 1967.

AR101264

15. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles - Users Manual, Davis, California, October 1973.

16. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles Computer Program 723-X6-L202A, Error Corrections 01 thru 09R2, Modifications 52 thru 58, Davis, California, October 1973.

17. U. S. Department of the Interior, Geological Survey, 7.5 Minute Series (Topographic) Maps, Scale 1:24,000, Contour Interval 20 feet: Swanville, Pennsylvania; Erie South, Pennsylvania; Erie North, Pennsylvania; and Hammett, Pennsylvania Quadrangles, Washington, D. C., 1969.

18. All States Aerial Surveys, Millcreek Township Topographic Map, Scale 1:2,400; Contour Interval 5 feet: Pittsburgh, Pennsylvania, 1973.

19. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study for the City of Erie, Erie County, Pennsylvania, Unpublished.

20. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study for the Township of Fairview, Erie County, Pennsylvania, Unpublished.

Chow, Ven Te, Handbook of Applied Hydrology, New York, McGraw-Hill, 1964.

Chow, Ven Te, Open-Channel Hydraulics, New York, McGraw-Hill Book Co., 1959.

Linsley, Ray K., Max A. Kohler, and Joseph L. H. Paulus, Hydrology for Engineers, New York, McGraw-Hill Book Co., 1958.

Pennsylvania Department of Forests and Waters, Elevations of Major Floods Along Pennsylvania Rivers, U. S. Department of Interior Geological Survey, Harrisburg, Pennsylvania, 1942.

Pennsylvania Department of Internal Affairs, Geologic Map of Pennsylvania, Topographic and Geologic Survey, Harrisburg, Pennsylvania, 1969.

Pennsylvania Office of Planning and Development, Flood Plain Information for the Commonwealth of Pennsylvania, Vol. 5, Ohio River Basin, Michael Baker, Jr., Inc., Beaver, Pennsylvania, November 1974.

Shaw, L. C., and W. F. Busch, Pennsylvania Gazetteer of Streams, Part 1, Pennsylvania Department of Environmental Resources, Harrisburg, Pennsylvania, 1971.

(red)

U. S. Army Corps of Engineers, Hydrologic Engineering Center, Application of the HEC-2 Bridge Routines, Training Document No. 6, Davis, California, June 1974.

U. S. Army Corps of Engineers, Hydrologic Engineering Center, Floodway Determination Using Computer Program HEC-2, Training Document No. 5, Davis, California, May 1974.

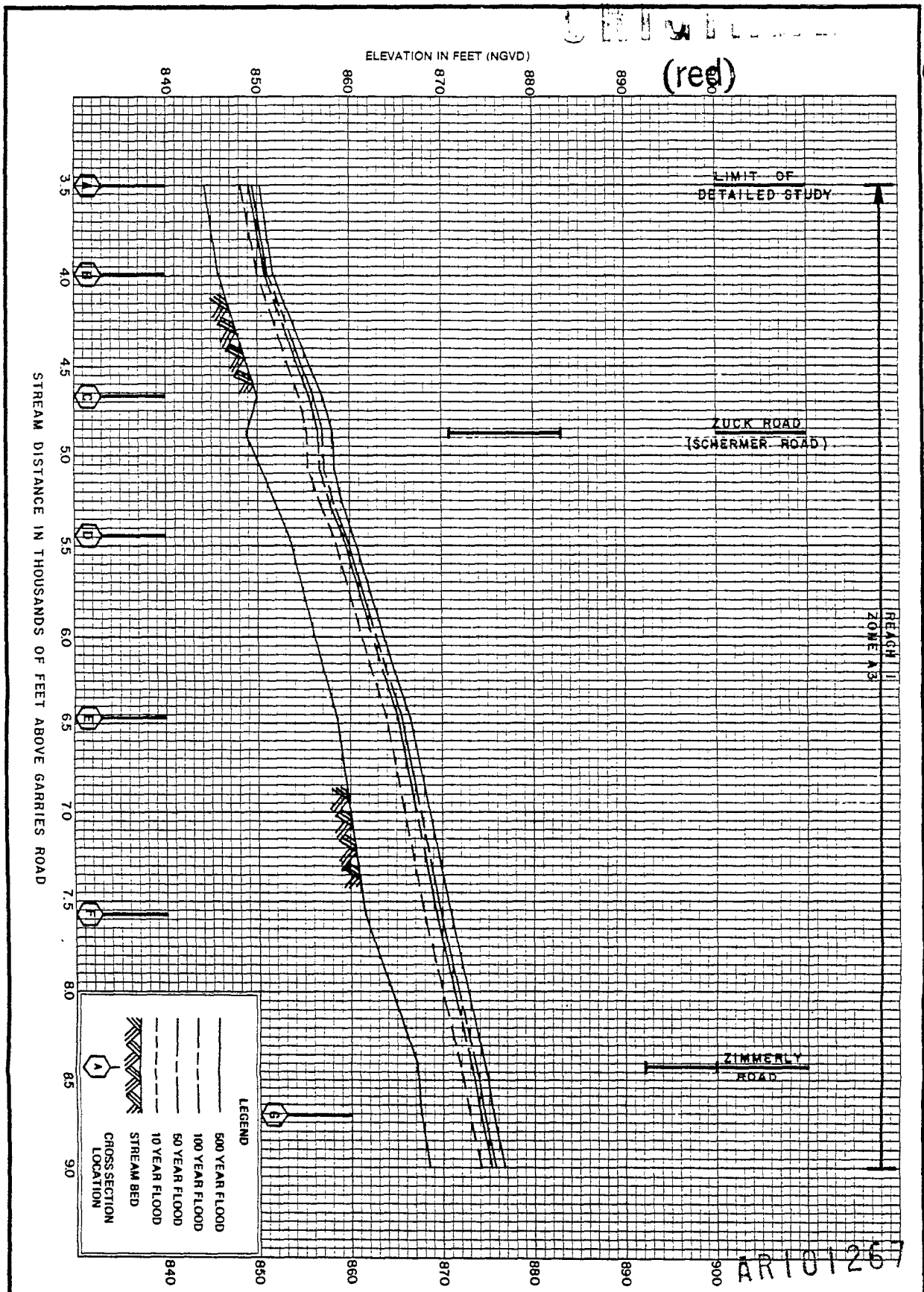
U. S. Army Corps of Engineers, Hydrologic Engineering Center, Hydrologic Frequency Analysis, Davis, California, April 1975.

U. S. Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release No.. 55, Washington, D. C.: 1975.

U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Climatological Data for Pennsylvania, Washington, D. C., 1974.

U. S. Department of the Interior, Geological Survey, Water Resources Data for Pennsylvania, Part 1, Surface Water Records, U. S. Department of the Interior, Geological Survey, Harrisburg, Pennsylvania, 1961-1975.

D 112



DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF MILLCREEK, PA
(ERIE CO.)

FLOOD PROFILES

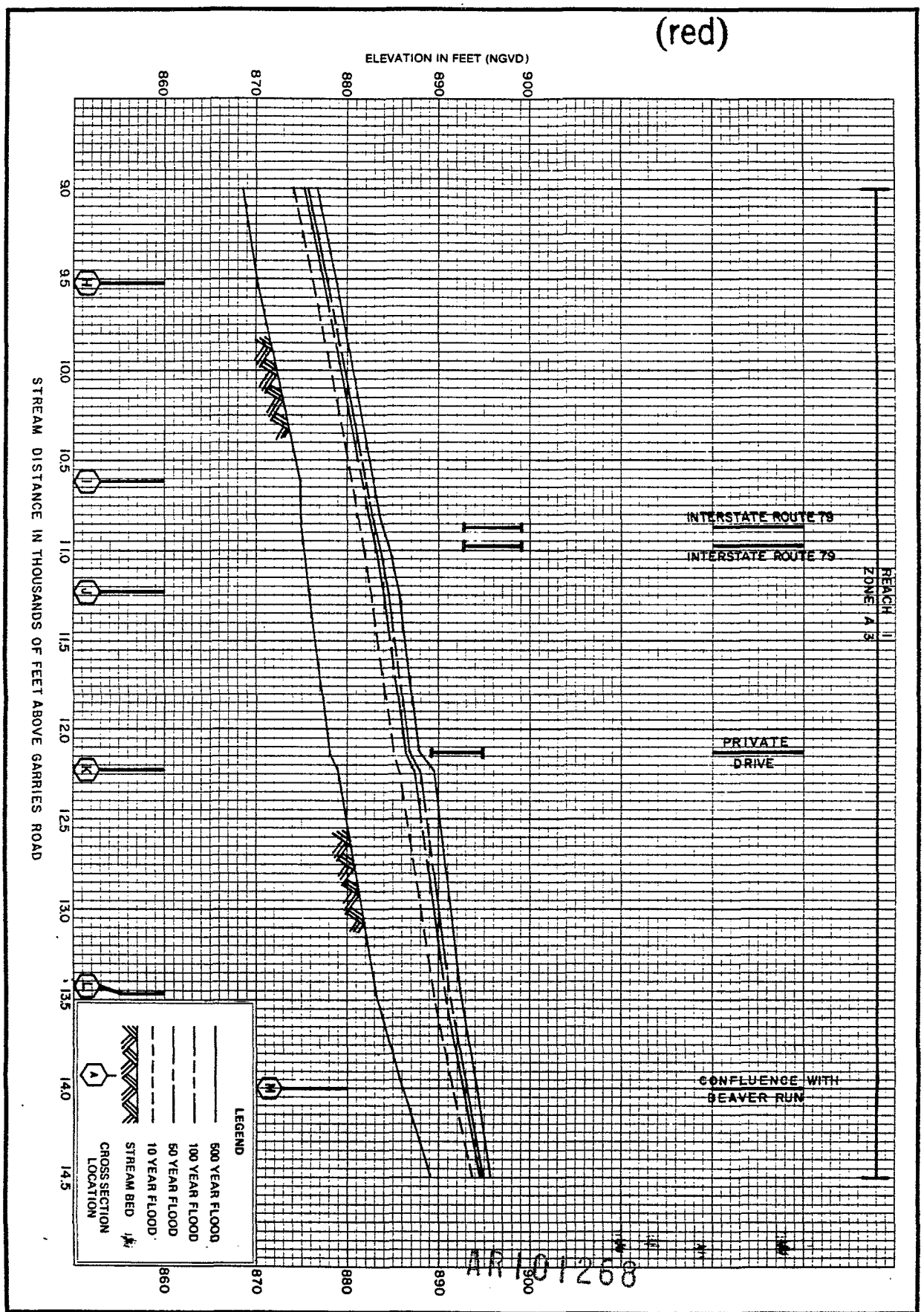
WALNUT CREEK

01P

P 113

ORIGINAL

(red)



AR 101268

02P

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF MILLCREEK, PA
(ERIE CO.)

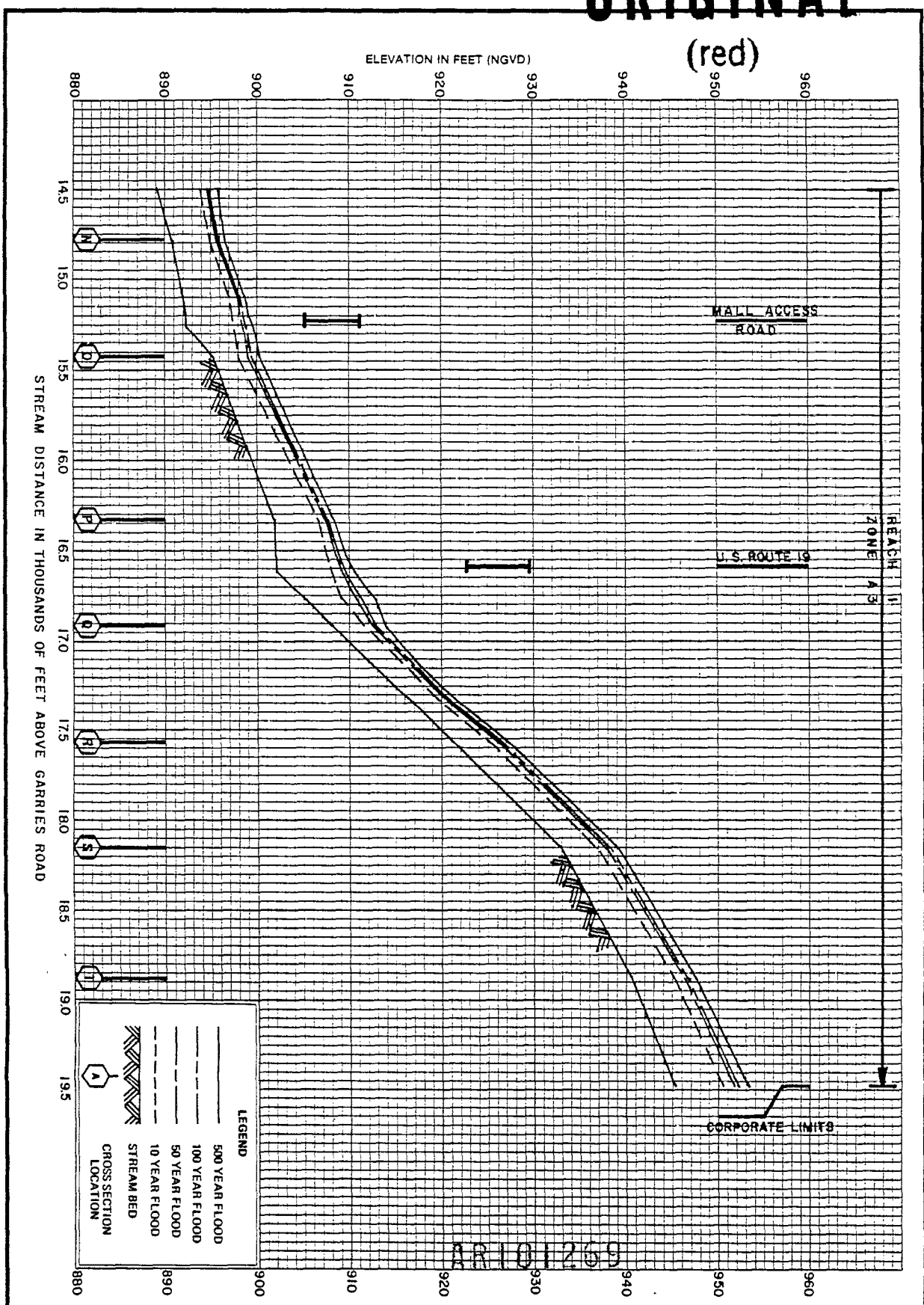
FLOOD PROFILES

WALNUT CREEK

P-114

ORIGINAL

(red)



ARI01269

03P

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF MILLCREEK, PA
(ERIE CO.)

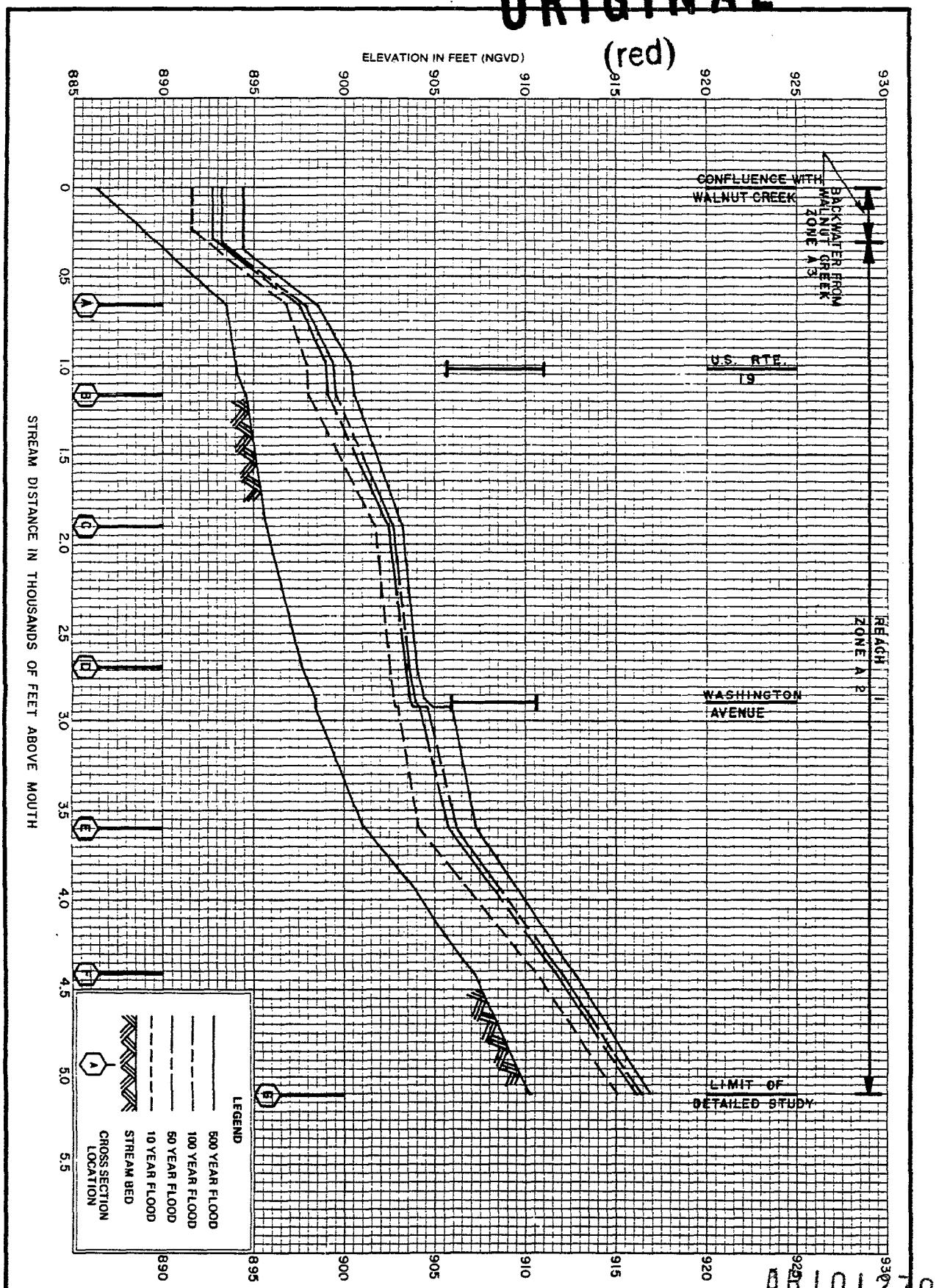
FLOOD PROFILES

WALNUT CREEK

D-115

ORIGINAL

(red)



AR 101270

04P	DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT Federal Insurance Administration TOWNSHIP OF MILLCREEK, PA (ERIE CO.)	FLOOD PROFILES BEAVER RUN